(7)

Reg.No.:												

VIVEKANANDHA COLLEGE OF ENGINEERING FOR WOMEN
[AUTONOMOUS INSTITUTION AFFILIATED TO ANNA UNIVERSITY, CHENNAI]
Elayampalayam – 637 205, Tiruchengode, Namakkal Dt., Tamil Nadu.

Question Paper Code: 120012

B.E. / B.Tech. DEGREE END-SEMESTER EXAMINATIONS – NOV. / DEC. 2025
Fifth Semester
Biomedical Engineering
U23BM513 – MEDICAL IMAGE PROCESSING
(Regulation 2023)

Time: Three Hours | Maximum: 100 Marks

Answer ALL the questions

Knowledge Levels (KL)	K1 – Remembering	K3 – Applying	K5 - Evaluating
	K2 – Understanding	K4 – Analyzing	K6 - Creating

PART – A

(10 x 2 = 20 Marks)

Q.No.	Questions	Marks	KL	CO
1.	State any two arithmetic operations in image processing.	2	K1	CO1
2.	Using an example, apply 2D DFT to a simple image matrix.	2	K2	CO1
3.	Name any two smoothing spatial filters.	2	K1	CO2
4.	Differentiate between log transformation and power-law transformation with respect to contrast enhancement.	2	K2	CO2
5.	Give the significance of boundary detection in segmentation.	2	K2	CO3
6.	Define region of Interest (ROI) in medical image processing.	2	K1	CO3
7.	Write the importance of principal axes registration in medical imaging.	2	K2	CO4
8.	List two methods of registration.	2	K1	CO4
9.	Give the significance of segmenting blood vessels in retinal images	2	K2	CO5
10.	Apply the confusion matrix to calculate sensitivity and specificity for a Computer Aided Diagnosis system.	2	K2	CO5

PART – B

(5 x 13 = 65 Marks)

Q.No.		Questions	Marks	KL	CO
11.	a)	Discuss discrete sampling and quantization in image digitization. Why are these processes needed in medical image processing?	13	K2	CO1
		(OR)			
	b)	Analyze the relationship between neighboring pixels and explain how this relationship is useful in edge detection and segmentation of medical images.	13	K2	CO1
12.	a)	Explain frequency domain filtering in medical image enhancement. Explain the significance of homomorphic filtering in medical image enhancement.	13	K2	CO2
		(OR)			
	b)	Analyze the effectiveness of hybrid filters for medical image enhancement. Compare their performance with conventional filters.	13	K3	CO2
13.	a)	Explain spatial filtering and frequency domain filtering methods for restoring an image corrupted by noise. Provide suitable examples.	13	K3	CO3
		(OR)			
	b)	Illustrate the different region-based segmentation techniques in image processing, such as region growing, region splitting and merging. For each technique, explain the method with an example.	13	K3	CO3
14.	a)	Describe surface-based rendering and volume visualization techniques. How do they differ in medical imaging applications?	13	K2	CO4
		(OR)			
	b)	Evaluate the effectiveness of surface-based rendering versus volume visualization for 3D medical image interpretation with examples.	13	K4	CO4
15.	a)	Outline the feature extraction methods in medical imaging, focusing on shape and texture features. Explain their importance in diagnosis.	13	K2	CO5
		(OR)			
	b)	Compare the effectiveness of DCT-based and wavelet-based image compression techniques across various medical imaging modalities. Analyze the trade-offs between compression ratio and the resulting image quality.	13	K4	CO5

PART – C

(1 x 15 = 15 Marks)

Q.No.		Questions	Marks	KL	CO
16.	a)	Given a 3-bit image of size 4×5 as shown below:	15	K3	CO2

$$\begin{bmatrix} 2 & 0 & 3 & 1 & 4 \\ 5 & 2 & 6 & 7 & 3 \\ 1 & 4 & 0 & 2 & 1 \\ 3 & 5 & 6 & 7 & 0 \end{bmatrix}$$

Perform the following tasks:

1. Compute the histogram of the image.
2. Calculate the cumulative distribution function (CDF) of the histogram.
3. Apply histogram equalization using the CDF to obtain the equalized image.
4. Compare the original and equalized images, explaining how the equalization improves the contrast and visual quality of the image.
5. Discuss the advantages and limitations of using histogram equalization in image enhancement.

(OR)

	b)	A medical imaging system acquires CT images that are corrupted by additive Gaussian noise during transmission. You are tasked with restoring the images while minimizing the reconstruction error. Question: As an image processing engineer: 1. Derive the mathematical expression for the Wiener filter that minimizes the mean squared error in the presence of noise. 2. Explain how the Wiener filter uses both the power spectral density of the original image and the noise to optimally estimate the true image. 3. Discuss why this approach is preferred over simple inverse filtering in practical scenarios.	15	K5	CO5